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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/656,470

09/05/2003

Arvind Halliyal

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06/10/2004

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EXAMINER

TRAN, LONG K

ART UNIT

PAPER NUMBER

2818

DATE MAILED: 06/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.		Applicant(s)	
	10/656,470		HALLIYAL ET AL.	
	Examiner		Art Unit	
	Long K. Tran		2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 April 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 - 20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9, 10-20 is/are rejected.
- 7) ☒ Claim(s) 8 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>9/5/03</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. This office action is in response to Response and Amendment filed on April 5, 2004.

Information Disclosure Statement

2. This office acknowledges of the following items from the Applicant:
Information Disclosure Statement (IDS) filed on September 5, 2003.
The references cited on the PTO -1449 form have been considered.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims **1 – 7** and **9 – 20** are rejected under 35 U.S.C. 102(e) as being anticipated by Ma et al. (US Patent No. 6,407,435 IDS).

Regarding claim **1**, Ma et al. disclose a semiconductor device having a composite dielectric layer, comprising: a semiconductor substrate (fig. 3 112), alternating sub-layers (fig. 3, 116) comprising a first dielectric material (fig. 3, 130) and a second dielectric material (fig. 3, 140) on the semiconductor substrate, the sub-layers

forming a composite dielectric layer having at least two sub-layers of at least one of the first dielectric material and the second dielectric material, wherein one of the first dielectric material and the second dielectric material is a high-K dielectric material and an other of the first dielectric material and the second dielectric material is a standard-K dielectric material comprising aluminum oxide (col. 4, lines 24+);

Ma et al. do not explicitly specify a reaction product of the high-K dielectric material and the standard-K dielectric material. However, Ma et al. teach a step (550) which is the annealing of the multilayer dielectric stack at temperature range from 400°C to 900°C to condition the high-k layers and the interposing layers (which are low-k layers) as well as the interfaces between the various layers (col. 7, lines 19 – 28). The device was formed of above combination of references and claimed device are identical in structure. So, it inherently possesses the same characteristic as claimed device. Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. In re Best, 195 USPQ 430, 433 (CCPA 1977). "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." In re Spada, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). Therefore, the prima facie case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed product. In re Best, 195 USPQ 430, 433 (CCPA 1977).

Regarding claim 2, Ma et al. disclose the standard-K dielectric material further comprises at least one of silicon dioxide, silicon nitride and aluminum oxide (col. 4, lines 32 – 36).

Regarding claim 3, Ma et al. disclose the high-K dielectric material comprises at least one of hafnium oxide, zirconium oxide, tantalum oxide (col. 4, lines 36 – 46).

Regarding claim 4, Ma et al. disclose the claimed invention of claim 1 but do not explicitly specify the reaction product comprises a high-K derived metal atom, an aluminum atom and an oxygen atom. However, it is known and also stated in the application specification that *"the high-K dielectric material is hafnium oxide and the standard-K dielectric material is aluminum oxide, the reaction product is an aluminate compound containing hafnium, aluminum and oxygen"* (page 15, lines 19 – 21). The multilayer dielectric stack in Ma et al. comprising hafnium oxide and aluminum oxide is annealed at an elevated temperature similar to that of the applicant's process. The device was formed of above combination of references and claimed device are identical in structure. So, it inherently possesses the same characteristic as claimed device. Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. In re Best, 195 USPQ 430, 433 (CCPA 1977). "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." In re Spada, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). Therefore, the prima facie case can be rebutted by evidence showing that the

prior art products do not necessarily possess the characteristics of the claimed product.
In re Best, 195 USPQ 430, 433 (CCPA 1977).

Regarding claims **5** and **6**, Ma et al. disclose the first and second dielectric material can be either high-K or standard-K dielectric material in a reverse order (col. 4, lines 53 – 56).

Regarding claim **7**, Ma et al. disclose that the multilayer dielectric stack is: $\text{Al}_2\text{O}_3/\text{ZrO}_2/\text{Al}_2\text{O}_3/\text{ZrO}_2/\text{Al}_2\text{O}_3/\text{ZrO}_2$. As discussed in claims 1 and 4 above, after annealing in an elevated temperature a reaction product layer appears between high-K material and standard-K material. Therefore, the composite dielectric layer in Ma et al. comprising: sub-layers ($\text{Al}_2\text{O}_3/\text{ZrO}_2$), a reaction production layer (not shown) and a sub-layers ($\text{Al}_2\text{O}_3/\text{ZrO}_2$).

Regarding claim **9**, Ma et al. disclose the number or patterns of composite dielectric layers could repeat many times (fig. 3; col. 4, lines 47 – 48).

Regarding claim **10**, Ma et al. disclose that the multilayer dielectric stack is: $\text{Al}_2\text{O}_3/\text{ZrO}_2/\text{Al}_2\text{O}_3/\text{ZrO}_2/\text{Al}_2\text{O}_3/\text{ZrO}_2$ As discussed in claims 1 and 4 above, after annealing in an elevated temperature a reaction product layer appears between high-K material and standard-K material. Therefore, the composite dielectric layer in Ma et al. comprising: pair of sub-layers ($\text{Al}_2\text{O}_3/\text{ZrO}_2/\text{Al}_2\text{O}_3/\text{ZrO}_2$), a reaction production layer (not shown) and a pair of sub-layers ($\text{Al}_2\text{O}_3/\text{ZrO}_2/\text{Al}_2\text{O}_3/\text{ZrO}_2$).

Regarding claim **11**, Ma et al. disclose the composite dielectric layer (fig. 1, 16/ fig. 3, 116) is a gate dielectric layer in the semiconductor device (col. 3, lines 36 – 46; col. 4, lines 26 – 31).

Regarding claim **12**, Ma et al. disclose the composite dielectric layer (fig. 1, 16/ fig. 3, 116) is a gate dielectric layer formed on the semiconductor substrate (Fig. 1, 12; fig. 3, 112; col. 3, lines 36 – 46; col. 4, lines 26 – 31).

Regarding claim **13**, Ma et al. disclose a semiconductor device having a composite dielectric layer, comprising: a semiconductor substrate (fig. 3 112); a composite gate dielectric layer (fig. 3, 116); the composite gate dielectric comprising a first and a second dielectric material, wherein one of the first dielectric material and the second dielectric is a high-K material an other of the first dielectric material and the second dielectric material is a standard-K dielectric material (Al_2O_3) (col. 4, lines 24+);

Ma et al. do not explicitly specify a reaction product of the high-K dielectric material and the standard-K dielectric material; and the reaction product comprises a high-K derived metal atom, an aluminum atom and an oxygen atom. However, Ma et al. teach a step (550) which is the annealing of the multilayer dielectric stack at temperature range from 400°C to 900°C to condition the high-k layers and the interposing layers (which are low-k layers) as well as the interfaces between the various layers (col. 7, lines 19 – 28). The device was formed of above combination of references and claimed device are identical in structure. So, it inherently posses the same characteristic as claimed device. Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. In re Best, 195 USPQ 430, 433 (CCPA 1977).

"When the PTO shows a sound basis for believing that the products of the applicant and

the prior art are the same, the applicant has the burden of showing that they are not." In re Spada, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). Therefore, the prima facie case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed product. In re Best, 195 USPQ 430, 433 (CCPA 1977).

Regarding claim **14**, Ma et al. disclose the standard-K dielectric material further comprises at least one of silicon dioxide, silicon nitride and aluminum oxide (col. 4, lines 32 – 36).

Regarding claim **15**, Ma et al. disclose the high-K dielectric material comprises at least one of hafnium oxide, zirconium oxide, tantalum oxide (col. 4, lines 36 – 46).

Regarding claim **16**, Ma et al. disclose a semiconductor device having a composite dielectric layer, comprising: a semiconductor substrate (fig. 3, 112); alternating sub-layers (fig. 3, 116) comprising a first dielectric material (fig. 3, 130) and a second dielectric material (fig. 3, 140) on the semiconductor substrate, the sub-layers forming a composite dielectric layer having from 3 to about 10 sub-layers of the first dielectric material and the second dielectric material (col. 4, lines 46 – 48), each pair of sub-layers separated by a sub-layer of a reaction product of the high-K dielectric material and the standard-K dielectric material, wherein one of the first dielectric material and the second dielectric material is a high-K dielectric material and an other of the first dielectric material and the second dielectric material is a standard-K dielectric material comprising aluminum oxide (Al_2O_3) (col. 4, lines 24+).

Ma et al. do not explicitly specify a reaction product of the high-K dielectric material and the standard-K dielectric material. However, Ma et al. teach a step (550) which is the annealing of the multilayer dielectric stack at temperature range from 400°C to 900°C to condition the high-k layers and the interposing layers (which are low-k layers) as well as the interfaces between the various layers (col. 7, lines 19 – 28). The device was formed of above combination of references and claimed device are identical in structure.. In re Best, 195 USPQ 430, 433 (CCPA 1977). "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." In re Spada, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). Therefore, the prima facie case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed product. In re Best, 195 USPQ 430, 433 (CCPA 1977).

Regarding claim **17**, Ma et al. disclose the standard-K dielectric material further comprises at least one of silicon dioxide, silicon nitride and aluminum oxide (col. 4, lines 32 – 36).

Regarding claim **18**, Ma et al. disclose the high-K dielectric material comprises at least one of hafnium oxide, zirconium oxide, tantalum oxide (col. 4, lines 36 – 46).

Regarding claim **19**, Ma et al. disclose the composite dielectric layer (fig. 1, 16/ fig. 3, 116) is a gate dielectric layer in the semiconductor device (col. 3, lines 36 – 46; col. 4, lines 26 – 31).

Regarding claim **20**, Ma et al. disclose the composite dielectric layer (fig. 1, 16/ fig. 3, 116) is a gate dielectric layer formed on the semiconductor substrate (Fig. 1, 12; fig. 3, 112; col. 3, lines 36 – 46; col. 4, lines 26 – 31).

Allowable Subject Matter

5. Claim **8** is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

6. The following is an examiner's statement of reasons for the indication of allowable subject matter: Claims **8** is allowable over the prior art of record because none of the prior art whether taken singularly or in combination, especially when these limitations are considered within the specific combination claimed, to teach:

a substantially uniform layer (fig. 1, 110rp) of the reaction production of the first dielectric material and the second dielectric material.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Response to Arguments

7. Applicants' arguments with respect to claims **1 – 7** and **9 – 20** have been fully considered but they are not persuasive.

8. The applicants agree that annealing at temperatures ranging from 400°C to 900°C would be insufficient to form the composite disclosed and claimed by applicants.

The examiner disagrees because the 435 's patent disclosed the temperatures ranging from 400°C to 900°C (column 7 lines 25), this range of temperature would be fall within the range temperature of the claimed invention. Further, the applicants has admitted the possibility of causing the reaction to take place between the high K and standard K materials to form a composite dielectric material, as claimed (page 6 last paragraph of the remark), therefore the claimed invention would be anticipated to the 435's patent.

Conclusion


THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Long K. Tran whose telephone number is 571-272-1797. The examiner can normally be reached on Mon-Thu.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on 571-272-1787. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Long Tran 
June 2, 2004


David Nelms
Supervisory Patent Examiner
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